

CONNECTICUT RIVER FLOOD CONTROL PROJECT

SPECIFICATIONS

FOR CONSTRUCTION OF

NORTH MEADOWS DIKE

HARTFORD - WPA NORTH MEADOWS PROJECT

CONNECTICUT RIVER

HARTFORD, CONNECTICUT

OCTOBER 1, 1938.

CORPS OF ENGINEERS, U. S. ARMY

U. S. ENGINEER OFFICE

PROVIDENCE, R. I.

WAR DEPARTMENT
UNITED STATES ENGINEER OFFICE
PROVIDENCE, R. I.

December 13, 1938.

ADDENDUM NO. 1 TO "SPECIFICATIONS FOR CONSTRUCTION OF NORTH MEADOWS DIKE,
HARTFORD - WPA NORTH MEADOWS PROJECT, CONNECTICUT RIVER, HARTFORD, CON-
NECTICUT, OCTOBER 1, 1938.

The following modifications are made to the detailed specifications for the construction of the North Meadows dike in Hartford, Connecticut.

ADDENDA TO DETAILED SPECIFICATIONS

Page 22, Par. 5-06b(1), line 14. - Change sentence to read:
"After dumping, the materials for the impervious section shall be bulldozed or otherwise spread in approximately 8-inch layers and immediately rolled; * * * *."

Page 23, Par. 5-06d(1). - Change first sentence to read:
"Rolling for the impervious section of the embankment * * * *."

Page 23, Par. 5-06d(2). - Insert after the first sentence the following: "Each set of twin oscillating rollers shall be pulled over the fill by a separate tractor."

Page 24, Par. 5-06f. - Delete the word "impervious" in the first line.

Page 27, Par. 6-02b. - In the third line, change the word "thirty" to "ten". In the fourth line, change "1/4-inch" to "2-inch".

WAR DEPARTMENT
UNITED STATES ENGINEER OFFICE
PROVIDENCE, RHODE ISLAND

June 8, 1939

ADDENDUM NO. 2 TO "SPECIFICATIONS FOR CONSTRUCTION OF NORTH MEADOWS DIKE,
HARTFORD - WPA NORTH MEADOWS PROJECT, CONNECTICUT RIVER, HARTFORD, CONNECTI-
CUT, OCTOBER 1, 1938."

The following modifications are made to the specifications for
the construction of the North Meadows dike in Hartford, Connecticut.

ADDENDA TO TABLE OF CONTENTS

On 2d page, under SECTION III. Excavation, add:

"3-07 River Sand Dredging Direct to Embankment 5 A"

ADDENDA TO GENERAL PROVISIONS

Page 3, Paragraph 1-07. - In the list of quantities, change the
quantity for Item 5 from 550,000 to 888,000; after Item 5, insert Item 5 A
as follows:

"5 A River sand dredging direct to
embankment cu.yds. 450,000"

ADDENDA TO DETAILED SPECIFICATIONS

Page 15, Paragraph 3-01 d. - Add classification item as follows:

"(4) River Sand Dredging Direct to Embankment (Item 5 A) (see Paragraph 3-07)"

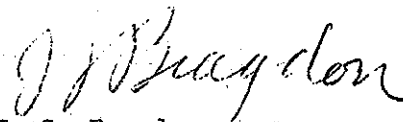
Page 18. - After Paragraph 3-06, insert Paragraph 3-07 as follows:

"3-07. River sand dredging direct to embankment (Item 5 A). - a. Work included. - The Area Engineer shall dredge river sand from the indicated borrow areas or other approved areas, directly to its final position in the embankment as directed by the District Engineer. Applicable provisions of Paragraph 3-04 a shall govern the work. The amount of material dredged directly to place in the embankment shall not exceed that necessary to construct the lower 15 feet of the pervious section of the embankment prism as shown on the drawings, unless otherwise directed by the District Engineer.

"b. Construction methods. - The provisions of Paragraph 3-04 b shall apply. Care shall be taken to exclude from the embankment unsatisfactory materials such as large stones, clay chunks, wood or other debris. All unsatisfactory materials shall be disposed of in approved spoil areas as directed by the District Engineer. The discharge pipe shall be located at the landside face of the embankment to secure a suitable gradation of material as directed by the District Engineer, with the coarser material adjacent to the landside face of the embankment. The construction operations shall insure that the dredged material shall be placed to line and grade in approximately 12-inch layers, for the full width of the pervious section of the embankment as directed by the District Engineer and for a length of embankment section not exceeding 800 feet unless otherwise directed by the District Engineer. Sufficient baffle-boards or other means shall be used to control the operation. Suitable provisions shall be made for draining water back to the river with a minimum loss of approved material, and with no gullyng or washing of any portion of the constructed embankment. Successive 12-inch layers of material shall be placed as directed by the District Engineer for as much of the full height of the pervious section of the embankment as may be practicable in the opinion of the District Engineer. The material required for the remainder of the pervious and random sections of the embankment shall be excavated and re-handled as required for work under Item 5 according to the provisions of Paragraph 3-04.

"c. Measurement and credit. - See Paragraph 3-05 d. Credit shall include all costs of excavating and transporting the material to the embankment."

This addendum is to be attached to the specifications and forms a part thereof.



J. S. Bragdon
Lieut. Col., Corps of Engineers
District Engineer

SECTION I. GENERAL PROVISIONS

Paragraph No.	Paragraph Title	Page No.
1-01	Location	1
1-02	Work to be Done	1
1-03	Organization	1
1-04	Responsibility of the District Engineer	1-2
1-05	Description of Project	2
1-06	Drawings	2-3
1-07	Quantities	3-4
1-08	Physical Data	4
1-09	Lands, Rights of Way, Damages	4-5
1-10	Removal of Rubbish	5
1-11	Datum and Bench Marks	5
1-12	Lines, Grades, Stakes and Templates	5
1-13	Planimeter	5-6
1-14	Responsibility for Work	6
1-15	Borrow Areas	6
1-16	Soil Classifications	6
1-17	Material Purchased by the District Engineer	9
1-18	Liability and Safety Requirements	9
1-19	Use of Explosives	9-10
1-20	Order of Work	10
1-21	Plant Organization	10
1-22	Employment of Labor	10-11
1-23	Purchase of Supplies and Materials	11
1-24	Quality and Inspection of Supplies and Materials	11-12
1-25	Cost Accounting	12
1-26	Protection of Existing Structures	12
1-27	Final Examination and Acceptance	12

DETAILED SPECIFICATIONS

Paragraph No.	Paragraph Title	Item No.	Page No.
	SECTION II. PREPARATION OF SITE	1	
2-01	Work Included		13
2-02	Clearing		13
2-03	Grubbing		13
2-04	Removal of Structures		13
2-05	Disposal of Materials		13-14
2-06	Credit		14
	SECTION III. EXCAVATION (Items 2 to 7 incl.)		
3-01	Classification		15
3-02	Stripping	2	15-16
3-03	Common Excavation - General	3	16
3-04	Common Excavation - Borrow Pit	4 & 5	17
3-05	Common Excavation - Cutoff Trench	6	17-18
3-06	Rock Excavation	7	18
	SECTION IV. STEEL SHEET PILING	8	
4-01	Work Included		19
4-02	Type and Properties		19
4-03	Material		19
4-04	Driving		19
4-05	Measurement and Credit		19
	SECTION V. EARTH DIKE	9 & 10	
5-01	Definitions		20
5-02	Work Included		20
5-03	Materials		20-21
5-04	Plowing		21
5-05	Filling of Excavations in Embankment Area		21
5-06	Rolled Fill		22-23-24
5-07	Removal of Objectionable Material		24-25
5-08	Slides		25
5-09	Frozen Materials		25
5-10	Shrinkage or Settlement		25
5-11	Test Pits and Water Table Indicators		25
5-12	Temporary Drains and Ditches		25
5-13	Topsoil and Seeding		25
5-14	Gravel for Top of Dike		25
5-15	Measurement and Credit		25-26

Paragraph No.	Paragraph Title	Item No.	Page No.
SECTION VI. MISCELLANEOUS FILL AND BACKFILL (ITEMS 11 and 12).			
6-01	Definitions		27
6-02	Selected Pervious Fill	11	27
6-03	Semi-compacted Backfill	12	27-28
SECTION VII. RIPRAP AND DRAINS (Items 13 to 16 incl.)			
7-01	Definitions		29
7-02	Riprap - Hand Placed	13	29
7-03	Crushed Stone Drains	14	29-30
7-04	Tile Drains	15	30-31
7-05	Grouted Stone Gutters	16	31-32
SECTION VIII. MISCELLANEOUS (Items 17 to 21 incl.)			
8-01	Placing Topsoil and Sodding Embankment Slope	17 & 18	33-34-35
8-02	Bituminous Macadam Road Surface	19	35-37
8-03	Gravel for Top of Dike	20	37-38
8-04	Cleaning Up	21	38

October 1, 1938.

WAR DEPARTMENT
UNITED STATES ENGINEER OFFICE
PROVIDENCE, R. I.

APPROPRIATION: Emergency Relief, 1938.

EARTH DIKE AT NORTH MEADOWS ALONG CONNECTICUT RIVER

HARTFORD, CONNECTICUT

S P E C I F I C A T I O N S

SECTION I. GENERAL PROVISIONS

1-01. Location. - The site of the work covered by these specifications is located on the west bank of the Connecticut River, in the north portion of the City of Hartford, Connecticut, known as the North Meadows.

1-02. Work to be done. - a. The work provided for herein is authorized by the Emergency Relief Appropriation Act of 1938.

b. The work to be done is the construction of an earth dike approximately 6,800 feet in length and the diversion of Meadow Brook, all to the grade and dimensions and otherwise complete, as shown on the drawings and described in these specifications. It includes furnishing all plant, labor and materials and performing all operations in connection with the following principal items of construction:

- (1) Construction of an earth dike between traverse stations 98 + 80 and 158 + 53, and between 162 + 53 and 168 + 00.
- (2) Construction of Meadow Brook diversion channel.
- (3) Steel sheet piling cut-off between traverse stations 98 + 00 and 159 + 63.

1-03. Organization. - The work described in these specifications will be executed by the Area Engineer whose responsibility shall correspond to that of "contractor" as defined in Article 1, standard construction contract form No. 23. The District Engineer as the officer responsible for the final accomplishment of the work specified will correspond to the "contracting officer."

1-04. Responsibility of the District Engineer. - a. The District Engineer will decide all questions which may arise as to performance,

quantity and quality, acceptability, fitness and materials to be furnished and used, and the rate of progress of the work as described by those specifications and will decide all questions which may arise as to interpretations of the specifications and drawings.

b. Changes which are necessary due to changed conditions in the field and necessitate a change in the specifications or drawings will be made in writing by the District Engineer provided that any change involving an estimated increase or decrease of more than \$500 will be subject to the final approval of the Division Engineer.

c. The work will be conducted under the general direction of the District Engineer and will be inspected by inspectors appointed by him. The organization of the inspection staff will be entirely separate from the Area Engineer's organization and will be directly responsible to the District Engineer. It is understood that any instructions given by the District Engineer through an inspector or other authorized employee are to be considered instructions or decisions of the District Engineer in all cases.

1-05. Description of project. - The section of earth dike covered by those specifications is of the rolled-fill type, top elevation 47.5± m.s.l. at the upstream end to elevation 47.3± m.s.l. at the downstream end, with an average height of 27 feet above the existing ground surface. The completed dike will be 6.0 feet above the grade recommended by the Board of Engineers for Rivers and Harbors. (See Paragraph 1-11.). The dike has a stool sheet piling cut-off. Construction of the Meadow Brook diversion channel is included in the project.

1-06. Drawings. - a. The work shall conform to drawings marked "North Meadows Dike, Hartford, Connecticut", comprising 13 drawings numbered and titled as follows:

(Drawings listed on following page)

<u>Sheet No.</u>	<u>Title</u>	<u>File No.</u>
1	Project Location and Index Plan of Subsurface Explorations North Meadows Dike (complete)	CT - 4 - 1110
2	Subsurface Explorations	CT - 2 - 1095
3	Record of Subsurface Explorations No. 1	CT - 2 - 1102
4	" " " " No. 2	CT - 2 - 1100
5	" " " " No. 3	CT - 2 - 1098
6	" " " " No. 4	CT - 2 - 1097
7	River Cross-Sections Construction Plans Hartford - WPA - North Meadows Project (Sta. 98 + 00 to 168 + 00 - exclusive of stop-log structure)	CT - 4 - 1114
8	Borrow Areas	CT - 4 - 1113
9	General Plan	CT - 4 - 1115
10	Layout of Steel Sheet Piling	CT - 4 - 1116
11	Meadow Brook Diversion	CT - 4 - 1117
12	Embankment Details	CT - 4 - 1118
13	Ramps	CT - 4 - 1119

all of which form a part of the specifications, and which are filed in the United States Engineer Office at Providence, Rhode Island.

b. The work shall also conform to such other drawings relating thereto used in explanation of details or minor modifications as may be furnished by the District Engineer from time to time during construction.

1-07. Quantities. - The following estimate of net quantities is given to serve as an indication of the extent of the work covered by these specifications.

<u>Item No.</u>	<u>Designation</u>	<u>Unit</u>	<u>Quantity</u>
1	Preparation of site	acres	45
2	Stripping	cu. yds.	41,000
3	Common excavation, general	" "	36,000
4	Impervious borrow excavation	" "	103,000
5	River sand excavation and stock piling	" "	550,000
6	Common excavation, cut-off trench	" "	29,000
7	Rock excavation	" "	150
8	Steel sheet piling	sq. ft.	158,800
9	Impervious fill, placing and rolling	cu. yds.	128,000
10	Pervious fill, placing and rolling, including haul from stock piles	" "	579,000
11	Selected pervious fill	" "	6,200
12	Semi-compacted backfill	" "	170
13	Riprap - hand placed	" "	10,350
14	Crushed stone drains	" "	3,800
15	Tile drains, 8" V.C. pipe	lin. ft.	970

<u>Item No.</u>	<u>Designation</u>	<u>Unit</u>	<u>Quantity</u>
16	Grouted stone gutters	sq. yds.	475
17	Topsoil on embankment	cu. yds.	26,500
18	Sodding and seeding	acres	20
19	Bituminous macadam road surface	sq. yds.	350
20	Gravel for top of dike	cu. yds.	1,850
21	Cleaning up		open

1-08. Physical data - a. General. - Materials for constructing the earth dike are available in the vicinity of the work. Locations of borrow areas are shown on the drawings. Borings and test pits have been made in the vicinity of the proposed work with reasonable care and substantially at the places indicated on the drawings. Laboratory analyses have been made of the samples from many bore holes and test pits. Samples of materials taken from them, and records of laboratory analyses and other studies may be seen at the United States Engineer Office, Providence, Rhode Island.

b. Transportation facilities - (1) Railroads. - The New York, New Haven and Hartford Railroad serves the City of Hartford with main line traffic, and adequate siding facilities are available in close proximity to the work. The Area Engineer shall investigate the availability of sidings, and make all arrangements with the railroad for any sidings necessary for delivery of materials and equipment to be used on the work, when necessary.

(2) Waterways. - A 15-foot channel with 94-foot minimum overhead clearance is maintained in the Connecticut River up to the highway bridge at Hartford, which is adjacent to the downstream end of the site of the North Meadows Dike. Above the bridge there is limited draft and overhead clearance. For navigation data see U.S.C. & G.S. Charts Nos. 215, 254, 255 and 256. The normal river stage is 3.5 foot m.s.l. at the Hartford bridge, and usually varies from a low stage of 1.5 foot m.s.l. in August to a high stage of 20+ foot m.s.l. in April. Freshets producing higher stages may occur at any month of the year as a result of heavy rainfall.

(3) Highways. - First-class highways also serve the city and there is reasonable access to all parts of the project. The Area Engineer shall construct and maintain all construction roads required, and investigate available roads for transportation, including load limits for bridges and roads, and any other road conditions affecting transportation of materials and equipment to the site.

c. Weather conditions. - The locality is subject to atmospheric temperatures ranging from minus 18 degrees to plus 101 degrees Fahrenheit. The mean annual precipitation at Hartford is 42.50 inches. The mean monthly precipitation varies from a low of 3.22 inches in June to a high of 4.20 inches in August.

1-09. Lands, rights of way, damages. - a. The District Engineer will designate the lands, rights of way and easements which will be re-

quired for the project, and the Area Engineer shall undertake the construction only when approved assurances shall have been obtained from local interests and when local cooperation has been assured as required by Section 3 of the Flood Control Act (Public No. 738 - 74th Congress).

b. In the pursuance of the work covered by these specifications, no money appropriated for the construction of the project will be expended until the City of Hartford has given assurances satisfactory to the Secretary of War that it will:

(1) Provide without cost to the Government all lands, easements, and rights of way necessary for the construction of the project as defined by these specifications.

(2) Hold and save the Government free from damages owing to the construction work.

(3) Maintain and operate all works after completion in accordance with regulations prescribed by the Secretary of War.

1-10. Removal of rubbish. - The Area Engineer shall keep the site free from rubbish. Suitable spoil areas for receiving refuse from the grounds shall be provided, and the rubbish shall be removed and disposed of as directed by the District Engineer and in a manner agreeable to the local interests and in accordance with the sanitary provisions of Paragraph 1-18 hereof. At the conclusion of the work, the site shall be cleaned up and all rubbish and unused materials shall be disposed of in accordance with Paragraph 8-09 of these specifications.

1-11. Datum and bench marks. - The plane of reference of Mean Sea Level as used in these specifications is that determined by the following bench mark:

Description of Bench Mark
F8 at Hartford

Hartford County on the New York, New Haven and Hartford Railroad, 60 feet west of the station, in Bushnell Park, 15 feet south of the south rail, 10 feet west of Asylum Street, 6 feet south of a high stone retaining wall, and 30 feet lower than the track. A standard U.S.C. & G.S. disk, stamped "F 8 36.98" and set in the top of a concrete post. Elevation 11.222 meters or 36.818 feet.

1-12. Lines, grades, stakes and templates. - The Government inspector will define and approve on request all points and elevations reasonably necessary for the prosecution of the work from lines and grades established by the survey party.

1-13. Planimeter. - For the estimating of quantities in which computation of area by arithmetic and geometric methods will be comparatively

laborious the planimeter shall be considered an instrument of precision adapted to the measurement of such areas unless otherwise directed by the District Engineer. Measurement of quantities in place after compaction will be used for cost keeping data.

1-14. Responsibility for work. - The Area Engineer shall take all responsibility for the work and take all precautions for preventing injury to persons and property in or about the work.

1-15. Borrow Areas. - Borrow areas will be furnished by the local interests without cost to the Government, including rights of way for transportation purposes across property not owned. If sufficient material is not available in the borrow areas indicated on the drawings or otherwise provided to complete the work, additional areas will be furnished without cost to the Government.

1-16. Soil classifications. - a. Soil classifications as referred to in these specifications conform to descriptive terms and limits of classifications as shown on Table No. 1 "Soil Classification" and Plate No. 1 "Diagram Showing Limits of Soil Classes", both of which form a part of these specifications.

b. Table No. 1 - Soil Classification.

(see page 7 for Table No. 1)

c. Plate No. 1 - Diagram Showing Limits of Soil Classes.

(see page 8 for Plate No. 1)

PROVIDENCE SOIL CLASSIFICATION
U.S. ENGINEER OFFICE
PROVIDENCE, R.I.

TABLE NO. 1

CLASS	DESCRIPTION OF MATERIAL
1	<u>Clean Gravel.</u> - Contains little coarse to medium sand.
2	<u>Uniform Coarse to Medium Sand.</u> - Contains little gravel and fine sand.
3	<u>Variable - Graded from Gravel to Medium Sand.</u> - Contains little fine sand.
4	<u>Uniform Medium to Fine Sand.</u> - Contains little coarse sand and coarse silt.
5	<u>Variable - Graded from Gravel to Fine Sand.</u> - Contains little coarse silt.
6	<u>Uniform Fine Sand to Coarse Silt.</u> - Contains little medium sand and medium silt.
7	<u>Variable - Graded from Gravel to Coarse Silt.</u> - Contains little medium silt.
8	<u>Uniform Coarse to Medium Silt.</u> - Contains little fine sand and fine silt.
9	<u>Variable - Graded from Gravel to Medium Silt.</u> - Contains little fine silt.
10	<u>Uniform Medium to Fine Silt.</u> - Contains little coarse silt and coarse clay. Possesses behavior characteristics of silt.
10 C	<u>Uniform Medium Silt to Coarse Clay.</u> - Contains little coarse silt and medium clay. Possesses behavior characteristics of clay.
11	<u>Variable - Graded from Gravel or Coarse Sand to Fine Silt.</u> - Contains little coarse clay.
12	<u>Uniform Fine Silt to Medium Clay.</u> - Contains little medium silt and fine clay (colloids). Possesses behavior characteristics of silt.
12 C	<u>Uniform Clay.</u> - Contains little silt. Possesses behavior characteristics of clay.
13	<u>Variable - Graded from Coarse Sand to Clay.</u> - Contains little fine clay (colloids). Possesses behavior characteristics of silt.
13 C	<u>Variable Clay.</u> - Graded from sand to fine clay (colloids). Possesses behavior characteristics of clay.

1-17. Material purchased by the District Engineer. - All orders, shipping bills or memoranda accompanying material purchased by the District Engineer shall clearly indicate weights and shall be so worded or marked that each item, piece or member can be definitely identified on the drawings.

1-18. Liability and safety requirements. - a. The Area Engineer shall be responsible that his employees strictly observe the laws of the United States affecting all operations at the site under the project. He shall comply with all applicable Federal and state laws under which he is operating, including those concerning the inspection of boilers, hulls, and other equipment, the licensing of engineers, masters and other employees.

b. The Area Engineer shall conduct the work with due regard to adequate safety and sanitary requirements and shall maintain his plant and equipment in safe condition. He shall conform to current safety engineering practices as set forth in the Manual of Accident Prevention in Construction, published by the Associated General Contractors of America; the publications of the National Safety Council, and with all applicable state or local safety and sanitary laws, regulations and ordinances.

c. The District Engineer will require such safety and sanitary measures to be taken as the nature of the work and the conditions under which it is to be performed, demand. Such measures shall include:

(1) The provisions of adequate extinguishers or fire-fighting apparatus in and about all buildings and plant erected or used at the site of the work;

(2) Adequate first aid and life saving equipment;

(3) Adequate illumination during night operations;

(4) Watchman service at any railroad crossings used by employees for access to the site;

(5) Warning lights between sunset and sunrise and during fogs, on all cofferdams, vessels, range piles and other obstructions placed in navigable waters during the progress of the work;

(6) Instruction in accident prevention to reach all employees;

(7) Such machinery guards, safe walkways, scaffolds, ladders, bridges, gang planks and other safety devices, equipment and apparel as are necessary to prevent accidents or injuries.

d. The Area Engineer shall report promptly to the District Engineer in form prescribed by him all accidents occurring at the site of the work.

1-19. Use of explosives. - All blasting shall be done in the most careful manner so as not to endanger life, property, or the work. Explosives used shall be of a quality and power approved by the District

Engineer. Dynamite in a frozen condition shall not be used. Approved explosives shall be stored before use in a suitable magazine, in an approved location, in compliance with state and local laws and regulations. Detonators shall be kept in a separate magazine not less than 100 feet from the explosive magazine. Magazines shall be plainly marked with large letters "EXPLOSIVES - DANGEROUS" and shall be kept locked. Accurate daily records shall be kept to account for each piece of explosive and detonator from the time of delivery at the magazine until its discharge in use.

1-20. Order of work. - The work covered by these specifications shall be commenced on the date designated by the District Engineer and shall be completed on or before June 30, 1939. In the pursuance of the work covered by these specifications, no money shall be expended on the construction of the project until the state, political subdivisions thereof, or other responsible agencies have given assurances satisfactory to the Secretary of War that the required easements and rights of way have been furnished according to the provisions of Paragraph 1-09. The work shall be carried on at such localities and in such order of precedence as may be found necessary by the District Engineer. The location and limits of the work to be done will be plainly indicated by the District Engineer or his agents by stakes or otherwise. The District Engineer may suspend the work wholly or in part for such periods as he may deem necessary on account of conditions considered unfavorable for the suitable prosecution of the work. Proper lights each night, between the hours of sunset and sunrise, shall be maintained on or about the site of the work as the District Engineer deems necessary for the proper conduct and inspection of the work and the safety of employees when night work is performed. Danger lights and barricades shall be placed, in accordance with the laws of the State of Connecticut, on all intercepted highways and on such obstructions and hazards which encroach on, or are adjacent to, public rights of way.

1-21. Plant organization. - a. The Area Engineer shall provide sufficient plant of size suitable to meet the requirements of the work and shall maintain the plant and equipment in such condition to perform the work efficiently and economically within the time specified. An ample force shall be maintained to properly and efficiently conduct the work.

b. No reduction in the capacity of the plant employed on the work shall be made except when approved by the District Engineer. The measure of the "capacity of the plant" shall be its actual performance on the work to which these specifications apply.

1-22. Employment of labor. - The method of employment, rate of wages, and monthly hours of employment for the various classifications of workmen shall be in strict conformity with the schedule (or any authorized revision thereof) furnished by the Works Progress Administration for Hartford. The District Engineer will report to the Department of Labor monthly within five days after the close of each calendar

month on forms to be furnished by the Department of Labor, the number of persons employed on the project, the man-hours worked and the total expenditure for materials. No work shall be done on Sundays or on days declared by Congress as holidays for per diem employees of the United States except in cases of emergency, and then only with the written consent of the District Engineer. Night work, when necessary to maintain operating schedules, will be permitted upon written approval of the District Engineer. (see Paragraph 1-20).

1-23. Purchase of supplies and materials. - a. - Because the materials listed below, or the materials from which they are manufactured, are not mined, produced, or manufactured, as the case may be, in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality, their use in the work herein specified (subject to the requirements of the specifications) is authorized without regard to the country of origin:

Platinum	Rubber	Balsa wood
Chromium	Teakwood	English ball clay
Cork	Silk	English china clay
Jute	Sisal	Natural nickel copper
Kauri gum	Tin	alloy (monel metal)
Lac	Asbestos	
Nickel	China wood oil (tung oil)	

b. Articles, materials, or supplies manufactured in the United States and containing mercury, antimony, tungsten, or mica of foreign origin may be used (subject to the requirements of the specifications) in the work herein specified because such manufactured articles, materials, or supplies have been manufactured in the United States substantially all from articles, materials, or supplies mined, produced, or manufactured, as the case may be, in the United States.

1-24. Quality and inspection of supplies and materials. - a. All materials, supplies and articles used will be, insofar as is practicable, the standard stock products of recognized and reputable manufacturers and will be sufficient in strength, durability, usefulness and convenience for the purpose intended. All materials, parts and equipment shall be of the highest grade, free from defects and imperfections, of recent manufacture and unused. Workmanship shall be of the highest grade and in accordance with best modern practice.

b. All materials, supplies, and parts and assemblies thereof, purchased for the work covered by these specifications, shall be inspected in conformity with modern approved methods as directed by the District Engineer. Unless waived in writing by the District Engineer, all tests and trials shall be made in the presence of a duly authorized representative of the District Engineer. When the presence of the inspector is so waived, sworn statements, in duplicate, of the tests made and results thereof shall be furnished the District Engineer by the supplier. All costs of all tests and trials excepting the expenses of the

Government inspector shall be borne by the supplier and shall be included in the price bid.

1-25. Cost accounting. - a. The Area Engineer shall keep an accurate cost distribution record of all work done and shall submit a monthly cost report to the District Engineer. The cost shall be kept so that proper charges may be made against the items in Paragraph 1-07.

b. A separate account shall be kept of all labor charges in order that employees' compensation insurance may be determined.

c. The cost and expense of inspection and surveys shall be kept separately and not included in the actual cost of performing the work.

d. Prior to the commencement of the work, the Area Engineer shall prepare a Job Estimate Summary sheet (Form No. 18 Costs) in quadruplicate and forward same to the District Engineer, attaching thereto the engineering estimate for performing the work. The engineering estimate shall be prepared in a manner similar to that set forth in paragraphs 734.1, 734.2, and 734.3 of Orders and Regulations. The final cost shall reflect all charges contemplated in the estimate.

e. Nothing in this paragraph shall be construed as changing the method by which costs are now reported in monthly and annual reports required by the cost keeping manual.

1-26. Protection of existing structures. - During construction operations, on work covered by these specifications, the Area Engineer shall protect all existing structures and accepted work. Any disturbances or damage to any structures by operations under these specifications shall be repaired promptly by the Area Engineer without credit to the work.

1-27. Final examination and acceptance. - As soon as practicable after the completion of any section of the work as in the opinion of the District Engineer will not be subject to injury by further operations under these specifications, such section may be examined as deemed advisable by the District Engineer. The District Engineer will make a thorough examination of same and if it is found to fully comply with the requirements of the specifications, it will be accepted.

SECTION II. PREPARATION OF SITE (Item 1)

2-01. Work included. - Clearing, grubbing, removal of buildings and disposal of materials shall be done as directed by the District Engineer, within the limits shown on the drawings.

2-02. Clearing. - a. The areas to be cleared shall include, (1) the area within the limits of the foundation of the required earth dike, together with a 5-foot strip measured horizontally beyond and contiguous to the toe line on each side of the dike, (2) borrow pits, (3) the area within the limits of the Meadow Brook diversion channel, and (4) any other area designated by the District Engineer within the limits shown on the drawings.

b. Trees and other obstructions shall be removed by the Area Engineer from the sites of the proposed structures and of the borrow areas when and as directed by the District Engineer and may be removed from other areas only to the extent directed or permitted. The Area Engineer shall preserve and protect from injury all trees not required to be removed.

c. All timber, undergrowth, brush, logs, weeds, and debris of any nature shall be cleared and removed. Trees and brush 4 inches in diameter or less shall be cut at the ground surface. Trees exceeding 4 inches in diameter shall be cut not more than one foot above the ground.

2-03. Grubbing. - a. The areas to be grubbed shall include the areas previously cleared, as may be directed by the District Engineer.

b. All such areas shall be thoroughly grubbed of all stumps, roots, buried logs and other objectionable matter. Tap roots and other projections over 1-1/2 inches in diameter shall be grubbed out to a depth at least 3 feet below the ground surface, unless otherwise directed by the District Engineer. Old road beds shall be thoroughly broken up as directed by the District Engineer.

2-04. Removal of structures. - The removal of existing structures and utilities required to permit the orderly prosecution of the work covered by these specifications shall be accomplished by local agencies in a manner as directed by the Area Engineer and satisfactory to the District Engineer. Whenever a telephone or telegraph pole, pipe line, conduit, sewer or other utility is encountered and must be removed to permit completion of the work, the District Engineer will notify the proper local authorities, who shall take prompt action to have the designated utility expeditiously removed.

2-05. Disposal of materials. - All materials removed, as specified above, shall be disposed of by burning or by removal to approved disposal areas as directed. No material shall be thrown into, or left along the bank of, the river. The disposal of material shall closely

follow the operations of clearing and grubbing so that brush and other debris will not be washed into the river in case of high water. At no time shall material be placed on land adjacent to the construction area. No damage of any nature shall be inflicted upon adjoining property owners by unwarranted entry or disposal of material on adjacent property.

2-06. Credit. - Credit for all work in connection with the preparation of the site as above specified, including the loading, hauling and disposal of the materials, will be made by the acre under Item 1, "Preparation of Site."

SECTION III. EXCAVATION (Items 2 to 7 incl.)

3-01. Classification. - All materials excavated will be classified as follows:

a. Common excavation shall include all earth, clay, sand, gravel, and topsoil as defined below, also such hard and compact materials as hardpan, cemented gravel, shale and soft or disintegrated rock that can be removed by hand power shovels, or draglines without continuous and systematic blasting, and also all boulders and detached pieces of solid rock less than 1/2 cubic yard in volume.

b. The words "soil" or "topsoil" shall mean the material composing the surface layers of the ground containing varying amounts of organic matter.

c. Rock excavation shall include all solid rock in place that cannot be excavated by hand, power shovels, or draglines without continuous and systematic blasting, also all boulders or rock fragments 1/2 cubic yard or greater in volume.

d. Detailed classification is as follows:

(1) Stripping (Item 2) (see Paragraph 3-02).

(2) Common Excavation (see Paragraphs 3-03, 3-04, and 3-05).

General (Item 3).

Borrow Pit (Items 4 and 5).

Cut-off Trench (Item 6).

(3) Rock Excavation (Item 7) (see Paragraph 3-06).

3-02. Stripping (Item 2). - a. Work included. - (1) The Area Engineer shall strip the area specified herein or directed by the District Engineer to a sufficient depth to remove all material not suitable for the foundation of the dike as determined by the District Engineer. The unsuitable materials to be removed shall include sod, topsoil, rubbish below the ground surface not removed by clearing and grubbing, all loose, weathered or otherwise unsatisfactory rock and any other objectionable material.

(2) Topsoil and sod obtained from the stripping operations shall be stock-piled in an approved location to be used later in dressing earth dike slopes, unless otherwise authorized by the District Engineer.

b. Description. - The areas occupied by the earth dike, together with strips 5 feet wide beyond and contiguous to the toe line on either side as indicated on the drawings, shall be stripped to a

minimum depth of one foot. The rock stripping shall be removed in any convenient manner, except that blasting shall be restricted to light charges for the breaking up of boulders or large fragments, as directed by the District Engineer. Credit will be given for rock excavation for that material which comes within the definition of Rock (see Paragraph 3-01 c), under Item 7.

c. Disposal of materials. - The Area Engineer shall deposit suitable excavated materials in the required embankments as directed by the District Engineer, and shall waste in spoil banks in approved locations materials from the excavation that are unacceptable for use in the embankments as directed by the District Engineer. Materials, if any, which cannot be placed at once in permanent positions, may be deposited in storage piles at locations designated. The materials to be excavated from such storage piles will not again be credited as excavation.

d. Measurement and credit. - Measurement will be made by the cubic yard for the amount of material actually removed to the specified lines and grades or as directed by the District Engineer. Credit for all work in connection with stripping, including the loading, hauling, and disposal of the materials, will be made by the cubic yard under Item No. 2, "Stripping."

3-03. Common excavation - general. (Item 3) - a. Work included. - The Area Engineer shall excavate and dispose of the materials classified as common excavation above and below the mean water level in the river to the lines and grades shown on the drawings for the respective areas, or as otherwise directed by the District Engineer. Common excavation shall be done for the diversion channel of Meadow Brook. Common excavation includes excavation for the foundation of the earth dike additional to that included under Items 1 and 2, and any other required common excavation for drains, ditches and gutters not included in other items of the work.

b. Description. - Excavation for the diversion channel will be performed in accordance with a schedule of operations to be approved by the District Engineer. The work shall be commenced at the point farthest downstream, and shall progress upstream as directed. Care shall be taken not to close or restrict the old stream channel until the diversion channel has been completed, unless otherwise approved by the District Engineer.

c. Disposal of materials. - As directed by the District Engineer all suitable materials excavated under Item 3 shall be placed in the earth dike or miscellaneous fills. Excavated materials not used in such construction may be used by the Area Engineer in temporary construction if approved by the District Engineer or shall be disposed of otherwise in designated spoil areas as provided in Paragraph 3-02 c.

d. Measurement and credit. - See Paragraph 3-05 d.

3-04. Common excavation - borrow areas (Items 4 and 5). - a. Work included. - The Area Engineer shall excavate under Items 4 and 5 in the indicated borrow areas or other approved areas the materials to be used in the dikes or miscellaneous fills. Excavation shall include the transportation of the material to the point of disposal. Borrow pit excavation shall include the stripping of the pits and disposal of objectionable topsoil containing roots or other debris, and the removal and the disposal of any other objectionable material so designated by the District Engineer. To provide suitable fill materials excavations shall be made to the depths and in the locations as directed by the District Engineer. During and after excavation the borrow areas shall be so graded that the surfaces will blend into the surrounding topography and so that all surface water will readily drain from the areas. The borrow areas shall be left in a neat and sightly condition satisfactory to the District Engineer.

b. Description. - Under Items 4 and 5 shall be included the excavation from the borrow areas as shown on the drawings. The limit of excavation in the vicinity of the earth dike shall be as directed by the District Engineer. No borrow pit excavations will be permitted within 100 feet of the toes of the dike.

c. Disposal of materials. - The provisions of Paragraph 3-03 c shall apply.

d. Measurement and credit. - See Paragraph 3-05 d.

3-05. Common excavation - cut-off trench (Item 6). - a. Work included. - The Area Engineer shall excavate and dispose of the materials in the cut-off trench under the earth dike, both above and below the mean water level of the river to the lines and grades shown on the drawings, or as otherwise directed by the District Engineer. The required depth of the cut-off trench at all points cannot be known with certainty until the area is fully developed by the construction operations. The lines and grades shall include any necessary adjustment to field conditions.

b. Pumping and draining. - The Area Engineer shall do all pumping and draining necessary to perform the excavation in the dry, and to keep the cut-off trench unwatered until it has been satisfactorily back-filled with suitable material.

c. Disposal of materials. - The provisions of Paragraph 3-03 c shall apply. Excavated material which is not suitable for backfill of the cut-off trench shall be placed in the dike section adjacent to the cut-off trench as indicated on the drawings.

d. Measurement and credit. - Measurement for excavation work under Items 3 to 6, inclusive, will be by the cubic yard for the amount of material actually removed to the lines and grades shown on

the drawings or as staked in the field by the District Engineer. Quantities will be measured in place before excavation (see Paragraph 5-15 b). Credit for all work in connection with excavation under Items 3 to 6, inclusive, including the loading, hauling, and disposal of the materials, will be made by the cubic yard under Items 3, 4, 5, and 6, respectively, for the several items of excavation (see Paragraph 1-07).

3-06. Rock excavation (Item 7). - a. Work included. - The Area Engineer shall excavate and dispose of the rock excavated above and below the mean water level of the river to the lines and grades shown on the drawings or otherwise ordered by the District Engineer. (see Paragraph 3-03 a (2)). Rock excavation under Item 7 shall include any other ordered rock excavation not included in other items of the work.

b. Blasting. - (1) Blasting and the use of explosives shall be conducted as provided for in Paragraph 1-23.

(2) Blasting will be permitted only when proper precautions are taken for the protection of all persons, the work and the property. All damage done to the work or the property shall be repaired. All operations of the Area Engineer in connection with the transportation, storage, and use of explosives shall be as approved by the District Engineer.

(3) Explosives of such quality and power shall be used in the locations which will, in the opinion of the District Engineer, neither crack nor damage the rock outside the lines of excavation. Blasting shall be done only to the lines and grades shown on the drawings or approved by the District Engineer. The rock surface shall be prepared by drilling, picking, barring, wedging, or similar methods which will leave the rock in a solid and unshattered condition.

(4) Approval by the District Engineer of the method of blasting or the strength and amount of the explosive used, will not relieve the Area Engineer of his responsibility in the blasting operations.

(5) Generally, the faces of rock excavations shall be scaled to a tolerance not exceeding one foot each way from the designated neat-line for excavation shown on the drawings.

c. Disposal of materials. - The provision of Paragraph 3-03 c shall apply also to Item 7. Some stock-piling may be necessary.

d. Measurement and credit. - The quantity to be credited to the work under Item 7 will be the number of cubic yards excavated and satisfactorily disposed of in accordance with the drawings or as ordered. Quantities will be measured in place before excavation. Credit shall include the disposal of all excavated materials or other incidental work. Credit will be made by the cubic yard under Item 7, "Rock Excavation."

SECTION IV. STEEL SHEET PILING (Item 8)

4-01. Work included. - A steel sheet-piling cut-off wall shall be constructed under the earth dike as shown on the drawings. The cut-off wall shall be constructed of piles of varying lengths driven to grade, between the limits as shown on the drawings.

4-02. Type and properties. - The piles shall be of the arch web type and shall have a minimum thickness of metal of $\frac{3}{8}$ inch, except that a reasonable reduction for shaping the joints of the interlock will be permitted. The piles shall provide a section modulus of not less than 5.4 inches cubed per linear foot of wall and shall weigh not less than 22 pounds per square foot of wall, exclusive of any welded or riveted connection or reinforcement. The interlocked joint shall develop a strength in direct tension of not less than 8,000 pounds per linear inch of interlock without rupture. The piles shall be continuously interlocked throughout their entire length and shall be provided with standard pulling holes. The type and dimensions of the piles proposed to be furnished shall be approved in writing by the District Engineer before any order for delivery is given by the Area Engineer.

4-03. Material. - Steel for sheet piling shall conform to Federal Specification QQ-S-751 for "Steel: Structural (Including Steel for Cold Flanging) and Steel: Rivet (for) Ships other than Naval Vessels," Structural Grade.

4-04. Driving. - The piles shall be driven to form a continuous interlocking diaphragm down to the elevation established for the bottom of the cut-off wall, as shown on the drawings. A protecting cap shall be used in driving. The hammers shall be of a suitable size and type, either steam or air operated. The use of a water jet may be permitted at the discretion of the District Engineer. Piles shall be driven without injury to them, as true to line and grade as possible, and shall be cut off, where necessary, to the top elevation of the cut-off wall as shown on the drawings. Proper precautions shall be taken to prevent rupture at the interlocks. Piles ruptured at the interlock or otherwise injured shall be removed and replaced by new piles.

4-05. Measurement and credit. - The quantity of steel sheet piling to be credited to the work will be the number of square feet of sheet piling actually in place below the top elevation of the cut-off wall.

SECTION V. EARTH DIKE (Items 9 and 10)

5-01. Definitions. - The term "embankment" as used in these specifications includes earth fill of all types for the earth dike and cut-off trench, and all other specified or directed earth fills within the limits of the dike necessary to complete the embankment. As shown on the drawings, the various types of earth fill are "selected impervious" under Item 9, for the cut-off trench and the blanket on the river side of the embankment; the "pervious" under Item 10, forming the land-side shoulder of the embankment, and the "random" under Item 10 forming the section between the impervious and pervious sections.

5-02. Work included. - a. The Area Engineer shall grade and consolidate materials required for the embankment, to the elevation, lines, grades and cross sections shown on the drawings, with such increased height and width as may be deemed necessary by the District Engineer to allow for later shrinkage or settlement. The Area Engineer shall use suitable materials as approved by the District Engineer and excavated from the required excavations and approved borrow areas shown on the drawings.

b. The Area Engineer shall construct test pits and install water-table indicators as directed by the District Engineer.

5-03. Materials. - a. General. - All materials from required excavations will be used, if, as excavation proceeds, they are found suitable by the District Engineer for use in the embankment. Brush, roots, sod, any type of organic materials, and other perishable or unsuitable material as determined by the District Engineer shall not be placed in the embankment. Materials shall not be wasted except by specific instructions from the District Engineer.

b. Borrow. - (1) Other suitable materials shall be borrowed from locations shown on the drawings in accordance with Paragraphs 1-15 and 3-04. The origin of any material from either required or borrow excavations does not definitely determine where it will be used in the embankment. Materials from two or more excavation or borrow areas may be required to be used at the same time and in the same part of the embankment, mixing being done in the process of placing by systematic dumping, spreading and bulldozing. Materials from one area may be required to be used in different parts of the embankment.

(2) Suitable pervious materials shall be obtained by hydraulic methods from the river bed adjacent to the work. Such materials shall be stock-piled and allowed to dry until the moisture content is low enough to permit the placement of the materials in the embankment in accordance with the requirements of Paragraph 5-06.

c. Test requirements. - The various types of earth fill defined in Paragraph 5-01 shall conform to the test requirements and

approved classification established by the Soils Laboratory, U. S. Engineer Office, Providence, R. I. All test samples shall be taken under the supervision of the District Engineer and supplied to the Soils Laboratory by the Area Engineer. Subject to the approval of the District Engineer, the Area Engineer shall supply test samples in sufficient amount and frequency to give a comprehensive knowledge of the material and its placement and compaction in each section of the embankment.

5-04. Plowing. - Immediately prior to the placing of materials in the embankment, and after stripping has been completed (see Paragraph 3-02), the entire foundation of the embankment shall be thoroughly plowed and broken to a depth of 8 inches. The furrows shall run approximately parallel to the axis of the embankment. All roots, stones, and debris or other objectionable material shall be removed and disposed of, as directed by the District Engineer. The condition of the surface material of the foundation area at the time of plowing shall be slightly drier than the required moisture content for rolled fill. The requirements for plowing do not apply to the side slopes of the cut-off and toe trenches, and stump holes. Plowing shall be completed not less than 200 feet in advance of the embankment construction. After plowing, the entire surface of the foundation area shall be rolled in accordance with Paragraph 5-06 d.

5-05. Filling of excavations in embankment area. - a. General. - The cut-off trench, test pits, stump holes and other excavated areas within the limits of the embankment and as otherwise shown on the drawings shall be filled with pervious, random, or impervious materials in the dry as directed by the District Engineer. The fill shall be placed in layers, moistened, and rolled in accordance with Paragraph 5-06 whenever, in the opinion of the District Engineer, it is possible to do so. Material which cannot be compacted by roller equipment on account of clearances, shall be spread in 2-inch layers and compacted with hand or power tampers which shall give the degree of compaction required for the embankment. As the fill is brought up, the side slopes of the cut or hole shall be scarified by equipment or by hand if it is required, in the opinion of the District Engineer, in order to provide a bond between the fill and the original ground material. (see Paragraph 5-06 d (2)).

b. Stump holes. - The sides of stump holes shall be broken down with bulldozers or a disc harrow so as to flatten out the slopes, and the hole then filled with approved material and properly rolled or tamped in place.

c. Cut-off trench. - The fill for the cut-off trench shall be placed in the dry and rolled in accordance with Paragraph 5-06. The water shall be drained to a sump and removed by pumps. The fill shall be made by working the materials toward the sump and sloping the surface of the fill longitudinally toward the sump. Well points may be used for drying up the foundation when approved by the District Engineer.

5-06. Rolled fill. - a. General. - The selected impervious blanket and the pervious section of the embankment shall be constructed with a crown running with the center line of the dike and with slopes approximately on a 2 per cent grade toward the edges of the embankment. This slope shall be maintained until the completion of the embankment, thus bringing up together the impervious blanket and pervious section. As soon as practicable, the embankment shall be brought to a nearly uniform grade for each section of dike under construction. Subject to the approval of the District Engineer, the embankment construction shall proceed in sections of not less than 1,000 feet in length, and each section shall be carefully bonded to the preceding section.

b. Furnishing and placing. - (1) The Area Engineer may use power shovels, drag lines, or any type of excavating machinery which is capable of excavating the materials in dry condition. The District Engineer will specify the location in the borrow areas and the depth to which excavation shall be made. The Area Engineer may use any approved method of transporting materials in natural dry condition to approved locations in the embankment. The dumping of the successive loads shall be at locations as directed or approved by the District Engineer. Sufficient excavating and hauling equipment shall be available so that not less than two sources of material can be worked at the same time. When two or more different materials are being moved into a section of the embankment they shall be spotted and dumped systematically so that in any area of the section there are approximately the required proportions of the materials. After dumping, the materials for the impervious and random sections shall be bulldozed or otherwise spread in approximately 8-inch layers and immediately rolled; the materials for the random and pervious sections shall be spread in approximately 12-inch layers and rolled (see Paragraph 5-06 d). Should the material for the various sections of the embankment be too high in water content when dumped, it shall be bulldozed or otherwise spread and harrowed or stirred and left for a sufficient time to allow the surplus water to dry out before being rolled. If, in the opinion of the District Engineer, the rolled surface of any layer of the materials is too smooth to bond properly with the succeeding layer or, if the materials have dried out sufficiently to cause cracks in the surface, it shall be roughened or loosened by a disc harrow, or other approved means, and dampened, if required, before the succeeding layer is placed thereon. All roots, trash, and debris shall be promptly removed from the embankment and disposed of to the satisfaction of the District Engineer. Stones greater than 6 inches in diameter shall be removed from the impervious and random sections and when approved by the District Engineer, shall be placed in the pervious section of the embankment. The entire surface of the embankment shall be maintained in such condition that construction equipment can travel thereon. Routing of construction equipment shall be subject to direction by the District Engineer.

(2) Any embankment material lost or loosened, after being placed in the embankment and before the completion and acceptance

of the completed work, because of floods or other actions of the river, or because of any construction operation or for other causes shall be replaced to the satisfaction of the District Engineer.

(3) The Area Engineer shall cease work on the embankment at any time when, in the opinion of the District Engineer, satisfactory work cannot be done on account of rain, high water, cold weather, or other unsatisfactory conditions.

c. Moisture control. - To obtain the desired compactness for the varying kinds of materials used, the moisture content of the material being placed shall be the optimum required for satisfactory compaction. If required, the compacted surface shall be sprinkled as directed immediately before placing each new layer. The moisture content shall be sufficient to dampen the filled materials as required, but the amount of sprinkling shall be controlled so that no free water will appear on the surface during or subsequent to the rolling. An adequate supply of water shall be available. Jets shall not be directed at the embankment material with such force that the finer materials are washed out.

d. Compaction. - (1) Tamper type roller - Rolling for the impervious and random impervious sections of the embankment shall be done by a tamper type twin roller such as a "sheeps-foot" roller, water or sand ballasted, having tamping feet uniformly staggered over its cylindrical surface, and equipped with cleaners; or other satisfactory type of tamper roller as approved by the District Engineer. Each tamping foot shall project approximately 7 inches from the roller's cylindrical surface and shall have a face area of not less than 5 and not more than 7 square inches. The spacing shall be such as to provide a minimum of two tamping feet for each square foot of cylindrical surface. Addition or reduction in the number of tamping feet shall be made when directed by the District Engineer. The total weight of the roller in pounds divided by the total area of the maximum number of tamping feet in one row parallel to the axis of the roller shall be not less than 115 pounds per square inch tamping foot area with the drum empty, and not less than 200 pounds per square inch tamping foot area with the drum ballasted. The design and operation of the tamping roller shall be subject to the approval of the District Engineer.

(2) Rolling impervious section. - When the moisture content and condition of the spread impervious layers of the embankment are satisfactory to the District Engineer, they shall be rolled with tamper type twin rollers. The twin rollers shall be pulled by a crawler type tractor of suitable power, weighing not less than 20,000 pounds, manufacturer's standard weight, at a speed of approximately 2-1/2 miles per hour. Each square foot of each layer of the embankment material shall be compacted by not less than six passes of the rollers. Additional passes of the rollers shall be made if necessary to obtain the required compaction desired by the District Engineer. Successive trips of the rollers shall overlap by at least 2 feet. Failure to comply with this requirement for careful rolling will be a

cause for additional trips. Where new material abuts old material, either in place or in embankment, the old material shall be cut or broken by machine or hand methods approved by the District Engineer, until it shows the characteristic colors of undried materials, and the rollers shall work on both materials, bonding them together. Portions of the earth fill which the roller cannot reach for any reason shall be thoroughly compacted by tamping with hand or power tampers in 2-inch layers. The degree of compaction for such portions of the earth fill shall be equivalent to that obtained by sprinkling and rolling as specified for the other portions of the earth fill.

(3) Rolling random and pervious sections. - Rolling of the random and pervious sections of the embankment shall be the same as specified above except that a minimum of 3 passes of the rollers will be required. If, in the opinion of the District Engineer, better compaction can be obtained by the use of a plain cylindrical roller, or a Parson's disc tamping roller, the use of such a roller may be required. The disc tamping roller shall weigh not less than 1100 pounds per linear foot. When conditions of the work so require, at the direction of the District Engineer, rolling may be done by a crawler type tractor weighing not less than 20,000 pounds; in such cases a minimum of four passes of the tractor treads on each square foot of embankment area will be required.

(4) Tests for compaction. - Samples of all embankment materials for testing, both before and after placing and compaction, will be taken at frequent intervals under the supervision of the District Engineer. Corrections, adjustments and modifications of methods, selection of materials and moisture content will be made from these tests, to secure the maximum density of the materials in the embankment (see Paragraph 5-03 c).

e. Impervious fill. - Impervious fill shall be selected and secured from required excavations and borrow areas as directed by the District Engineer and shall be placed in the impervious section of the embankment throughout the entire length.

f. Random impervious fill. - Random impervious fill will consist of material excavated from the cut-off trench, which in the opinion of the District Engineer is unsuitable for backfilling the trench. It shall be placed adjacent to the trench as shown on the drawings.

g. Pervious fill. - The pervious fill shall be selected and secured from required excavations and borrow areas as directed by the District Engineer, and shall be placed in the pervious section of the embankment. The pervious section of the embankment shall be graded from the finer materials near the impervious blanket to the coarser materials near the land-side face of the embankment. Special care shall be taken to place the coarser material and cobbles adjacent to the land-side face of the embankment.

5-07. Removal of objectionable material. - The Area Engineer shall excavate, remove and dispose of any material from the embankment sections which the District Engineer considers objectionable in such locations, and

refill the area as directed in accordance with Paragraph 5-05.

5-08. Slides. - In case of slides in any part of the embankment during the construction or after completion, but prior to the final acceptance of the work, the Area Engineer shall cut out and remove the area specified by the District Engineer and then rebuild the excavated area in accordance with these specifications.

5-09. Frozen materials. - No earth shall be placed upon a frozen surface, nor shall frozen earth, snow or ice be placed in the embankment. In cases of emergency the District Engineer may require frozen material to be stock-piled for later use in the embankment.

5-10. Shrinkage or settlement. - The Area Engineer shall assume all responsibility for placing excess embankment material required by shrinkage or settlement during construction in so far as credit for fill in embankment is concerned, as such quantities are not deemed determinate. Excavation of excess materials from the borrow pits required by settlement and shrinkage will be included in the credit allowed for the respective items.

5-11. Test pits and water-table indicators. - In accordance with Paragraph 5-02 b test pits shall be constructed and water-table indicators shall be furnished and installed as directed by the District Engineer. When directed by the District Engineer, test pits shall be back-filled with approved materials in 2-inch tamped layers (see Paragraph 5-05 a). Water-table indicators shall be maintained as directed by the District Engineer, and when no longer needed they shall be capped, plugged or back-filled in an approved manner.

5-12. Temporary drains and ditches. - The Area Engineer shall maintain the site of the work and the grounds immediately adjacent thereto, free from collected surface water if, in the opinion of the District Engineer such collected water affects the safety or condition of the work. Such temporary drains and ditches shall be constructed as are deemed necessary and directed by the District Engineer.

5-13. Topsoil and sodding. - a. Placing topsoil. - Unless otherwise authorized by the District Engineer, a suitable topsoil shall be placed on the slopes of the earth dike as shown on the drawings. Credit for placing topsoil will be allowed under Item 17 (see Paragraph 8-01).

b. The areas upon which topsoil has been placed shall be sodded or seeded as specified in Paragraph 8-01. Credit for seeding and sodding will be allowed under Item 18.

5-14. Gravel for top of dike. - Unless otherwise directed by the District Engineer, the top of the dike shall be surfaced with a layer of gravel as shown on the drawings. Credit for placing the gravel surfacing will be allowed under Item 20 (see Paragraph 8-03).

5-15. Measurement and credit. - a. The quantities to be credited

under Items 9 and 10 will be the number of cubic yards placed as directed, measured in place after compacting. Credit shall include the work of preparing the base, spreading in layers, wetting, rolling or tamping, trimming to line, and shall include all labor and materials incidental to completing the embankment, not specifically included under other items. Credit will be made by the cubic yard under Items 9 and 10 as applicable (see Paragraph 1-07).

b. To determine the quantities for which credit will be allowed, a survey will be conducted prior to the beginning of the placing of the fill. The true surface condition will be shown by cross sections and profile and the measurement of the quantities will be based upon this survey. The quantities will be the volume between the original surface at the beginning of the work and the slope lines and grades as indicated on the drawings, as staked in the field or as directed by the District Engineer at the completion of the work.

c. Additional credit will be allowed to replace embankment washed out by flooding or scouring, or that required to be removed on account of slides, or the removal and disposal of all objectionable materials placed at the direction of the District Engineer; provided such replacement of embankment was not caused by negligence or carelessness of the Area Engineer. Quantities for additional credit will be measured as directed by the District Engineer.

SECTION VI. MISCELLANEOUS FILL AND BACKFILL (Items 11 and 12)

6-01. Definitions. - The term "selected pervious fill" includes the gravel blanket immediately underlying the various items of riprap as shown on the drawings, and the gravel required for filters. "Semi-compacted backfill" refers to miscellaneous backfill not completely compacted.

6-02. Selected pervious fill (Item 11). - a. Work included. - As shown on the drawings or as directed the Area Engineer shall place, in the locations designated, a layer of selected pervious fill upon which riprap will be placed. The Area Engineer shall also place a layer of selected pervious fill of the specified quality required for filters at the locations shown on the drawings or as directed by the District Engineer.

b. Materials. - Selected pervious fill shall consist of suitable coarse clean gravel of which, unless otherwise directed, not more than thirty per cent by weight will pass a No. 10 sieve. The gravel shall all pass a 4-inch square mesh screen and shall be satisfactorily graded. The material shall be obtained from approved borrow pits, be screened, and placed directly in position and consolidated by wetting to the extent directed.

c. Placing. - The material shall be placed as shown on the drawings or as directed, and with such hand-placing as may be necessary to trim to the required slopes. The Area Engineer will not be required to tamp or roll the material, but will be required to consolidate it with water to the extent directed so that no settlement or voids will later result.

d. Measurement and credit. - Measurement will be made by the cubic yard for the amount of selected pervious fill placed in the completed work to the lines and grades shown on the drawings or directed by the District Engineer. Credit for all work in connection with selected pervious fill will be made by the cubic yard under Item 11, "Selected Pervious Fill."

6-03. Semi-compacted backfill (Item 12). - a. Work included. - The Area Engineer shall place, grade and consolidate materials required for miscellaneous backfill over pipe drains and culverts, and at other locations as directed by the District Engineer. The material shall be placed in 12-inch horizontal layers with only such hand placing as may be necessary to trim to the required slopes. The Area Engineer will not be required to roll the material, but will be required to consolidate it with water to the extent directed so that no settlement or voids will later result. Hand tamping shall be done where required by the District Engineer.

b. Materials. - Materials shall be borrowed from locations shown on the drawings in accordance with Paragraph 1-15, or may be obtained from required excavations. Backfill material shall be free from stumps, roots, sod, rubbish or other unsuitable materials or substances.

c. Measurement and credit. - Measurement will be made by the cubic yard for the amount of semi-compacted backfill placed in the completed work to the lines and grades shown on the drawings or as directed by the District Engineer. Quantities will be measured in place after any settlement. Credit for all work in connection with furnishing and placing semi-compacted backfill will be made by the cubic yard under Item 12, "Semi-compacted Backfill."

SECTION VII. RIPRAP AND DRAINS (Items 13 to 16 incl.)

7-01. Definitions. - Riprap shall include "Riprap - Hand Placed", Item 13, required for the diversion channel and on the river side slope of the dike as shown on the drawings or as directed by the District Engineer. Drains shall include "Crushed Stone Drains", Item 14, required at the landside toe of the earth dike and elsewhere as shown on the drawings or as directed by the District Engineer; "Tile Drains", Item 15, connecting the toe drains of the earth dike to the drainage ditch as shown on the drawings; and "Grouted Stone Gutters", Item 16, required along the ramps as shown on the drawings.

7-02. Riprap - hand placed (Item 13). - a. Work included. - Riprap shall be placed, to the lines and grades shown on the drawings, on the banks of the diversion channel, on the river side slope of the dike and elsewhere as required by the District Engineer.

b. Material and placing. - Riprap shall be of durable rock of acceptable sizes with a specific gravity of not less than 2.65. Suitable rock from borrow pits, quarries and from the required excavations shall be used. The riprap shall be laid to the lines and grades shown on the drawings or as directed. A tolerance of 3 inches above or below the slope line shown on the drawings will be allowed for the finished slope surface of the hand-placed riprap. Rock for riprap shall be angular and of uniform shape so as to furnish an even, reasonably smooth surface. Not more than 5 per cent by weight of the rock shall be smaller than one-half cubic foot in volume and at least 75 per cent of the rock used shall be from 1 to 2 cubic feet in volume with one dimension approximately equal to the depth of the riprap course. The rock shall be closely laid on a base of selected pervious fill (see Paragraph 6-02), with the dimension normal to the slope, approximately equivalent to the depth of the riprap, and with joints broken where possible. The joints on the surface of the riprap shall be filled with tightly driven spalls. Large rock shall be well bedded at the edges of the riprap to prevent undermining.

c. Measurement and credit. - The quantity to be credited under Item 13 will be the number of cubic yards of riprap satisfactorily placed in the completed work to the specified or ordered lines and grades. Credit shall include all costs for furnishing, hauling and placing the riprap. Credit will be made by the cubic yard under Item 13, "Riprap-Hand Placed".

7-03. Crushed stone drains (Item 14). - a. Work included. - The Area Engineer shall construct crushed stone drains as indicated on the drawings, or as otherwise required by the District Engineer.

b. Description. - The toe drains at the land-side toe of the earth dike are stone-filled trenches, draining the land side toe of the embankment. The toe drains shall be constructed so that the

longitudinal slope will be towards a natural stream channel or other drain to facilitate free drainage of the embankment.

c. Materials. - The crushed stone back filling used shall consist of angular fragments of uniform quality throughout, of 4-inch maximum size, free from thin or elongated pieces, soft or disintegrated stone, dirt or other objectionable matter. It shall be graded so that not more than 50 per cent by weight of stone will be retained on a standard No. 2 mesh sieve with openings of 1-1/4 inches and not more than 15 per cent by weight shall pass a 3/4-inch mesh sieve.

d. Measurement and credit. - The quantity to be credited under Item 14, will be the number of cubic yards of crushed stone fill satisfactorily placed to the specified lines or grades in the completed work. Credit shall include all costs for furnishing, hauling, placing the crushed stone and trimming the fill, and will be made by the cubic yard under Item 14, "Crushed Stone Drains". Credit for trench excavation will be made as provided for in Paragraph 3-05 d.

7-04. Tile drains (Item 15). - a. Work included. - The Area Engineer shall furnish and lay tile pipes, including specials, of the required diameters for the drainage system on the land side of the earth dike as shown on the drawings.

b. Materials. - All pipes shall be bell-and-spigot, vitrified, salt-glazed, stoneware pipe conforming to the requirements of Federal Specification SS-P-361, or subsequent amendments or revisions thereof. Each pipe shall be carefully inspected immediately before laying and no cracked, broken or otherwise imperfect pipe shall be used, except for minor defects which in the opinion of the District Engineer do not impair the fitness of the pipe for the purpose intended.

c. Excavation. - Excavation shall be done as shown on the drawings and as provided for in Paragraph 3-03. Pipe trenches shall have a depth of not less than two feet and a width at least 12 inches greater than the outside diameter of the pipe. The bottom of the trench throughout its length shall be carefully formed to fit the circular shape of the pipe, so that the pipe shall be firmly supported on the bottom and for at least three inches up each side. All rock or boulders shall be removed to a depth of 6 inches below the bottom grade of the trench and the voids back-filled with well compacted suitable material.

d. Laying pipe. - All pipe shall be placed in the trench immediately after the excavation is completed. Proper care shall be used in handling the pipe to avoid injury or breakage. The pipe shall be carefully bedded, and properly connected and jointed. Bell holes shall be excavated to insure that each pipe shall rest firmly upon its bed for the entire pipe length. The pipes shall be laid true to the lines and grades shown on the drawings or as staked in the field. Joints shall be made with cement mortar composed of one part Portland cement and 2-1/2 parts sand, except where open joints are specifically authorized by the District Engineer. All mortar used shall be thoroughly

mixed either by hand or in a mechanical batch mixer. Mortar shall be prepared in such quantities that it can be used entirely before it has attained its initial set. The minimum amount of water sufficient to make a workable mortar shall be used. Cement and sand used in mortar shall be obtained from approved commercial sources and subject to the approval of the District Engineer. The spigots shall be centered in the bells, and there shall be no shoulders or unevenness of any kind along the bottom half of the pipes. Special care shall be taken that the joint space be of equal width around the pipe, making use of jute or oakum gaskets soaked in cement grout to center the pipe. The mortar shall be thoroughly troweled into the joint, and a sufficient overfill shall be made to hold the mortar in the joint firmly in place. The interior of the pipe shall be carefully cleaned after laying to remove dirt, mortar and other obstructions.

e. Backfilling. - Backfill material shall be evenly spread and compacted under and around the pipe. Backfill over the pipe shall be done in accordance with the provisions of Paragraph 6-03, unless otherwise shown on the drawings or directed by the District Engineer.

f. Measurement and credit. - (1) Measurement for credit will be based on the linear feet of pipe of the size installed. Credit for pipe will be made by the linear foot under Item 15, "Tile Drains" for the various sizes installed, and shall include all costs of furnishing and installing the pipe including specials, except the cost of excavation and backfilling.

(2) Credit for excavation will be made under Item 3 (see Paragraph 3-05 d). Credit for backfilling will be made under Item 12 (see Paragraph 6-03 c).

7-05. Grouted stone gutters (Item 16). - a. Work included. - (1) Hand-placed riprap shall be placed by the Area Engineer to the lines and grades shown on the drawings, for paving the gutters along the ramps at the locations shown on the drawings or elsewhere as directed by the District Engineer.

(2) The Area Engineer shall also furnish and place grout for surface grouting all hand-placed riprap in the gutters.

b. Material and placing. - (1) Riprap shall be of durable rock of acceptable sizes. Suitable rock from borrow pits, quarries and from the required excavation shall be used. The riprap shall be laid to the lines and grades shown on the drawings or as directed. The rock shall be hand-placed, to a tolerance of 1 inch above or below the finished surface shown on the drawings. No individual rock shall be less than 10 pounds or more than 30 pounds in weight, and at least 75 per cent of the rock used shall be at least 20 pounds in weight. The rock shall be closely laid on a base of selected pervious fill (see Paragraph 6-02), with the proper dimension normal to the slope, and with joints broken where possible.

(2) Grouting shall be done on clean riprap surface with a grout mixture of 1 part Portland cement and 2-1/2 parts sand by volume combined with water to a suitable consistency. Cement and sand used in the grout shall be obtained from approved commercial sources and subject to the approval of the District Engineer. The grout shall be worked into the joints of the riprap surface with brooms or other means so as to fill the voids completely.

c. Measurement and credit. - The quantity to be credited under Item 16 will be the number of square yards of riprap placed to the specified lines and grades in the completed work. Credit shall include all costs for furnishing, hauling, placing and grouting the riprap. Credit will be made by the square yard under Item 16, "Grouted Stone Gutters".

SECTION VIII. MISCELLANEOUS (Items 17 to 21 incl.)

8-01. Placing topsoil and sodding embankment slope (Items 17 and 18), - a Work included. - The Area Engineer shall furnish and place topsoil on the slopes of the earth dike as shown on the drawings, and on other areas as required by the District Engineer. The finished embankment dimensions shall be as shown on the drawings. Under Item 17, acceptable topsoil shall be placed to the required depth over the required areas. Under Item 18, the prepared topsoil surface shall be sodded, or shall be sown with first quality grass seed of an approved mixture, when and as directed by the District Engineer.

b. Placing topsoil. - Upon completion of the work required under Items 9 and 10, when the earth dike shall have the proper height and dimensions as required by the District Engineer, the Area Engineer shall apply the stored topsoil (see Paragraph 3-02 a (2)) or additional acceptable topsoil if required, to the required depth when compacted, over the slopes of the embankment to the limits shown on the drawings. The topsoil shall be lightly rolled or tamped and any unevenness of surface shall be corrected to conform to finished grades.

c. Sodding. - (1) The entire surface of the slopes of the earth dike shall be planted with living sods of Bermuda or some other acceptable grass which will best meet the climatic conditions, as directed by the District Engineer. Sods obtained by stripping operations (see Paragraph 3-02 a (2)) may be used if approved by the District Engineer. Each sod shall have an area of not less than 16 square inches. Sods shall be placed not more than 18 inches center to center for the minimum-sized sods; larger sods may be spaced proportionately, depending on their size. The District Engineer may require certain areas to be completely sodded in strips. Sods shall be covered with one to two inches of earth as directed by the District Engineer, in such manner as to protect the roots from drying out. Sods shall be placed as soon as practicable after cutting, and newly placed sods shall be kept moistened by sprinkling when and as required by the District Engineer for a period not exceeding two weeks after placement on the dike.

(2) Sodding shall be commenced immediately upon completion of a length of 1000 feet of dike to final grade and cross section and shall be prosecuted at a rate satisfactory to the District Engineer.

(3) Seeding may be allowed by the District Engineer in lieu of sodding if in his opinion the sod resulting from seeding operations would provide better protection for the newly constructed earth slopes. The District Engineer may also direct that seeding shall be done to supplement the sodding operations.

d. Seeding. - (1) Preparation. - All grass or cover crop seed shall be sown at the earliest practicable date in the spring, or when directed by the District Engineer, so as to secure the greatest possible protection against erosion. The finished surface grade of the slopes shall be maintained in a true and even condition during the seed-sowing operation, and the Area Engineer shall rake the soil to a depth

of three-quarters of an inch ($3/4$ ") by using iron rakes immediately previous to sowing seed. All raking shall be done in a direction parallel to the contour lines on the slope and not uphill or downhill. All sticks, stones, weeds or trash appearing on the surface shall be removed.

(2) Seed mixture. - The following mixture will be approved for each acre of seeding:

Perennial Rye Grass	7 lbs.
Orchard Grass	15 lbs.
Hard Fescue	4 lbs.
Kentucky Blue	6 lbs.
Sheep Fescue	6 lbs.
Timothy	7 lbs.
Perennial Red Clover	4 lbs.
White Clover	4 lbs.
Red Top	<u>7 lbs.</u>

Total per acre 60 lbs.

For all seeded areas, about 15 pounds of oats per acre shall be added if the planting is done between the middle of June and the middle of September, and about 15 pounds of winter rye per acre shall be added if the planting is permitted and done in the late season after the middle of September.

(3) Method of seeding. - The Area Engineer shall take advantage of favorable weather and shall employ a method of sowing satisfactory to the District Engineer. The seed shall be raked in and the whole surface then lightly rolled the same day, unless otherwise directed by the District Engineer. Seeding shall be done immediately after the preparation of the earth surface unless otherwise directed. If there be any delay, and if weeds grow in and with the grass, such weeds shall be cut before they go to seed or at such time as directed by the District Engineer. If any loam is washed away or any portions of the seeded areas are not covered by grass, the Area Engineer shall replace the topsoil, fertilize and re-seed.

(4) Maintenance. - The Area Engineer shall maintain the areas sown to grass seed on each section of the project, until all work on that section has been completed and accepted by the District Engineer. This maintenance shall consist of occasional mowing with a scythe or mechanical mower, watering during periods of drought, and removal of large and conspicuous weeds, or any other similar operations whenever required by the District Engineer. The turf areas shall be fertilized with an acceptable commercial lawn fertilizer of a quality equal to Vigoro or Scott's lawn fertilizer at the customary quantity per acre recommended by the manufacturer.

e. Measurement and credit. - (1) The quantity of topsoil

to be credited under Item 17 will be the number of cubic yards actually placed in accordance with directions, measured after compacting. Credit shall include the costs of all labor, materials and expenses incidental to furnishing and placing the topsoil. Credit will be made by the cubic yard under Item 17, "Topsoil on Embankment".

(2) The quantity to be credited under Item 18 will be the number of acres sodded and seeded as directed. The measurement will be the actual superficial areas sodded and seeded. Credit shall include all costs for sodding and seeding as specified in sub-paragraphs c and d above, and for all materials and expenses incidental thereto. Credit will be made by the acre under Item 18, "Sodding and Seeding".

8-02. Bituminous macadam road surface (Item 19). - a. Work included. - The Area Engineer shall furnish and place the bituminous macadam road surface shown on the drawings, in the locations shown on the drawings or otherwise designated by the District Engineer, after the gravel and riprap base shall have been placed in accordance with the drawings and the provisions of Paragraphs 6-02, 7-02 and 8-03. The bituminous macadam construction is required to surface a ramp which will provide access to the top of the earth dike. The surface course shall be composed of broken stone and bituminous material applied by the penetration method, with a bituminous seal coat and covering of pea stone.

b. Materials. - The broken stone for the surface course shall consist of clean crushed rock, thoroughly screened, uniformly graded in size and quality, angular and free from rounded surfaces; and no flat, elongated or otherwise objectionable stone shall be used. All stone shall meet the following requirements.

No. 1 Stone	
Square openings	Per cent passing
2-1/4"	90-100
1-1/4"	0- 40
3/4"	0- 5
Pea stone	
Square openings	Per cent passing
1/2"	90-100
1/4"	0- 20

The bituminous material to be used in this work shall be an approved product for the purpose, either oil asphalt or refined tar.

c. Placing. - (1) Shoulders shall be relined and graded before the surface course is spread, in order to hold the broken stone in place and to permit the roller to lap at least one-half the width

of the rear wheel when rolling the edge of the top course. A course of No. 1 stone shall then be spread upon the prepared base course to the ordered depth and dry rolled. The rolling shall be done by a self-propelled three-wheel roller weighing not less than 10 tons. Before the No. 1 stone is spread, the pea stone shall be deposited along the shoulders in convenient piles, from which it shall be spread on the surface course as directed. No hauling will be permitted over the No. 1 stone after it has been spread.

(2) The No. 1 stone shall be spread from approved self-spreading vehicles. The course shall be spread and shaped to a true section of such depth that when the surface is finished, the depth shall be as shown on the drawings and the top surface shall be at the required grade. Rolling shall continue until the course has been satisfactorily compacted to a uniform surface. Any depressions or irregularities which may occur shall be filled with broken stone as directed, and again rolled until the surface is true and unyielding. Precautions shall be taken to prevent the depositing of dirt or other materials in the voids of the broken stone.

(3) No bituminous material shall be applied on stone which has become coated or mixed with dirt or foreign substances. No bituminous material shall be applied unless the entire depth of No. 1 stone is thoroughly dry and the air temperature is at or above 50 degrees F. After the No. 1 stone has been prepared as above, the penetration coat of bituminous material shall be applied at the rate of 2 gallons per square yard by an approved pressure distributor, at approved temperatures appropriate for the grade of bituminous material used, and distributed under approved pressures of from 40 to 60 pounds per square inch.

(4) Immediately after the penetration coat of bituminous material has been applied, a thin layer of clean, dry pea stone shall be broadcast over the treated surface in such quantity as to fill all the surface voids and just cover the treatment uniformly. The surface shall then be broomed to break up all clumps and produce a uniform covering, after which the pavement shall be rolled, in the same manner as specified for the rolling of No. 1 stone, until thoroughly compacted and bonded. Additional pea stone shall be applied as required and directed. Upon completion of the rolling the pavement shall have a smooth, even surface, free from ruts, depressions, or other irregularities.

(5) As soon as practicable after the pea stone has been rolled, the pavement shall be swept clean of any loose material and shall be treated with a seal coat of bituminous material under the same conditions and in the same manner as specified for the penetration coat; except, that the rate of application shall be $3/4$ gallon per square yard. Immediately after the seal coat has been applied, a thin layer of clean dry pea stone shall be broadcast over the surface in such quantity as to uniformly cover the surface with all the stone that can be made to adhere to the bituminous material, care being taken to avoid an excess. This stone shall be broomed and rolled in the manner specified above, until

an unyielding, uniform and well-bonded surface is produced. Any damage to the finished surface caused by the working equipment or otherwise, shall be satisfactorily repaired.

d. Measurement and credit. - The quantity to be credited under Item 19 will be the number of square yards of bituminous macadam surface of the required quality and thickness satisfactorily placed in the work, measured after placing. Credit shall include all cost of furnishing materials, equipment, tools, labor and all work incidental to satisfactory construction. Credit will be made by the square yard under Item 19, "Bituminous Macadam Road Surface".

8-03. Gravel for top of dike (Item 20). - a. Work included. - The Area Engineer shall furnish and place gravel of the sizes and quality specified or directed for the surfacing of the top of the dike, and elsewhere on ramps, as shown on the drawings or as directed by the District Engineer.

b. Material. - The gravel shall be composed of hard, durable stones, together with sand and clay or other approved binding material, and shall be free from thin or elongated pieces. It shall be of such sizes that all will pass through a 3/4" screen with square openings, and not less than 35 per cent will be retained on a 1/4" screen with square openings. The gravel shall be uniformly graded. The finer material shall consist of sand and clay or other binding material approved by the District Engineer. Should the material as received for the work fail to maintain suitable proportions of coarse and fine particles, or should the coarse particles not be uniformly graded between the maximum and minimum sizes as specified, it shall be screened or manipulated in such a manner as to furnish a material to meet the above requirements.

c. Placing. - (1) The gravel surfacing shall be placed in one layer, and shall be 6" thick after compaction. After the sub-grade or foundation shall have been properly prepared and compacted and proper drainage provided, the gravel shall be spread evenly by means of approved spreader vehicles or trucks. The gravel as spread shall be well-graded with no pockets of fine material or segregation of large and fine particles. After being spread evenly, the gravel shall be graded and compacted to the required thickness, by successive trips of the hauling and grading equipment, until a firm even surface is obtained. If at any time the gravel does not contain a sufficient amount of moisture to insure proper binding of the material, water shall be added by means of a sprinkling wagon or any approved method in a sufficient amount to obtain the desired results.

(2) Compacting of the gravel shall start longitudinally at the side and gradually proceed toward the center of the roadway so far as practicable, overlapping on successive trips. During the process of compacting the gravel shall be dragged; the dragging and compacting shall continue until the gravel does not creep or wave under traffic.

d. Shoulders. - Shoulders shall be constructed as shown on the drawings and carefully maintained. Before the final completion of the work the shoulders shall be reformed, trimmed, and dressed as required by the District Engineer.

e. Measurement and credit. - Measurement will be made by the cubic yard for the amount of gravel surfacing furnished and placed in the completed work to the lines and grades shown on the drawings or as directed by the District Engineer. Quantities will be measured in place after compacting. Credit for all work in connection with gravel for top of dike, including furnishing, placing, and compacting the gravel will be made by the cubic yard under Item 20, "Gravel for Top of Dike".

8-04. Cleaning up (Item 21). - a. Work included. - The Area Engineer shall remove all construction equipment and all temporary structures built or used by him, shall remove rubbish of all kinds from the site of the work, and from any grounds which he shall have occupied within the limits of the work, and shall leave the site of the work in a clean condition satisfactory to the District Engineer. All materials salvaged shall be the property of the Government unless otherwise designated by the District Engineer.

b. Credit. - For all work, materials and incidentals required to clean up as set forth in a above, credit will be made for the lump sum stipulated under Item 21, "Cleaning Up".